

Technical expertise on the cause of engine failure of the Mitsubishi Pajero Sport

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ABSTRACT: *The article concerns the case of the damage to the Mitsubishi Pajero Sport engine and the methodology a technical expert applied to identify a direct cause of failure. The engine failure occurred while a vehicle was being repaired to eliminate air conditioning malfunction and engine overheating. When repairing, it was necessary to replace a cylinder head and the pistons were checked removing the pulley from a crank shaft. After the repair had been completed and after 16-day vehicle operation, engine timing belts got damaged. To eliminate this malfunction, damaged belts were replaced. Thirty (30) days after the vehicle had been put into operation, emergency engine failure occurred, and a technical expert was called upon to assess the quality of the repairs having been performed. The article describes the procedures and methodology a technical expert applied. In the conclusion, the findings are stated. To determine the cause, a vehicle was on the car service station premises, where a technical expert was present and according to his instructions, diagnostic and subsequent disassembly works have been done. The procedure of evaluating the key characteristics on individual parts, their display, and the resulting evaluation are described.*

KEYWORDS: *Vehicle, failure, engine, crankshaft, timing belt, pulley, technical expertise*

I. INTRODUCTION

There are often vehicle failures in a real life where it is necessary to analyse, assess and decide on how the failure occurred. For these reasons, technical experts inspect damaged parts and they consequently analyse the mode of failure. In addition to their expertise, also the knowledge of similar cases they can familiarise themselves with through the publication of investigations and analyses already performed, contributes to the quality of their work. This procedure increases the beliefs of technical experts that their investigation and outcomes will not contradict the already known case. Here, the engine failure occurred while the vehicle was being repaired to eliminate air-conditioning malfunction and engine overheating. When repairing, it was necessary to replace a cylinder head and the pistons were checked disassembling the pulley from a crankshaft. After the repair had been completed and after 16-day vehicle operation, engine timing belts got damaged. To eliminate this malfunction, damaged belts were replaced. Thirty (30) days after the vehicle had been put into operation, emergency engine failure occurred, and a technical expert was called upon to assess the quality of the repairs having been performed and materials used. To determine the cause, a vehicle was on the car service station premises, where a technical expert was present and according to his instructions, diagnostic and subsequent disassembly works were done. All operations have been documented and recorded by a video camera.

II. VEHICLE DATA

Make: Mitsubishi Pajero Sport
Mileage: 133 000 km
Mileage after the first repair: 2 300 km
View of a vehicle is shown in Fig. 1.



Figure 1: View of the Mitsubishi Pajero Sport

III. REVIEW OF PREVIOUS REPAIRS

Material provided at first repair:

VALVE
HEAD-MITSUBISHI PAJERO SPORT
RESPONSE DOT 4
PUMP BELT A/C
WEDGE
O-RING
VALVE COVER SEAL -PAJSPO
INJECTOR SEAL
WHEEL
SEAL
WIPERS
COVER
RING
HEAD GASKET-PAJERO SPORT
GLOW PLUG -PAJERO SPORT
INJECTION NOZZLES
INJECTORS

Based on the used material, it can be deduced that the valves, cylinder head and a timing belt were damaged and at the same time, glow plugs and engine injectors were replaced.

IV. VEHICLE INSPECTION

Operations: the disassembly of the pulley on a crankshaft and other parts, inspection of dismantled parts, inspection of the vehicle, making a video

The photographs taken upon the inspection of the vehicle and the vehicle engine, and the description of individual parts are in Fig. 2.

Vehicle



Engine



Pulley



Front part of a crankshaft with a wedge



Thread on a crankshaft



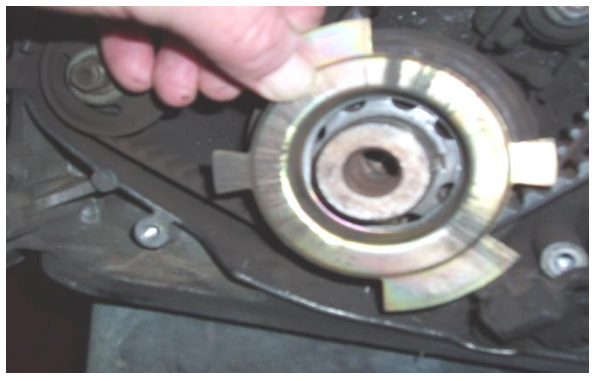
Pulley bolt washer



Pulley bolt



Speed sensor disc



Sensor disc

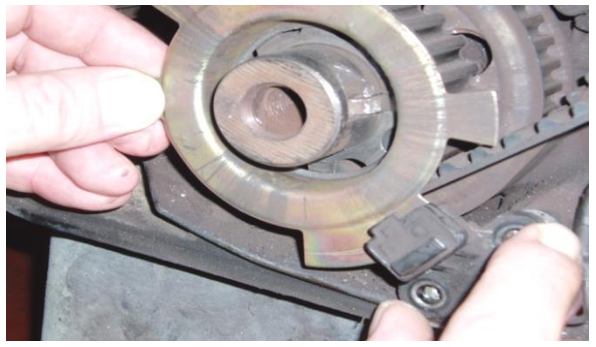


Figure 2: The photographs of damaged engine parts

V. MECHANICAL DESIGN OF THE PULLEY AND ENGINE SPEED SENSING

The crankshaft is provided with an internal thread at its end, into which the bolt fastening the pulley is screwed. A washer is placed under the bolt. The pulley is put onto the end of a crankshaft and its position is locked by a wedge.

The speed sensor disc, whose rotation is sensed by an engine speed sensor.

The relative position of parts in Figures 3,4:

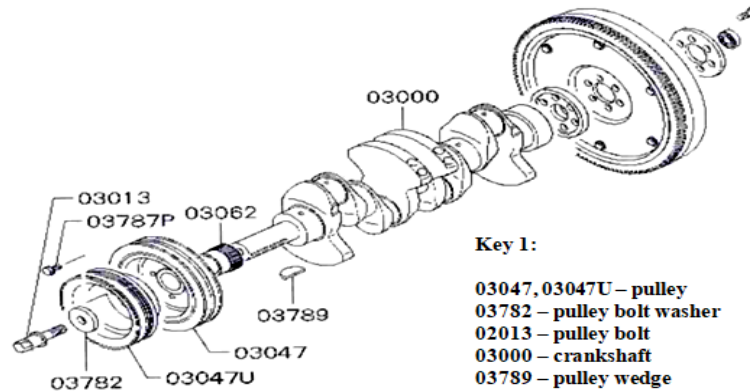


Figure 3: The relative positions of the pulley, pulley bolt washer, pulley bolt and pulley wedge

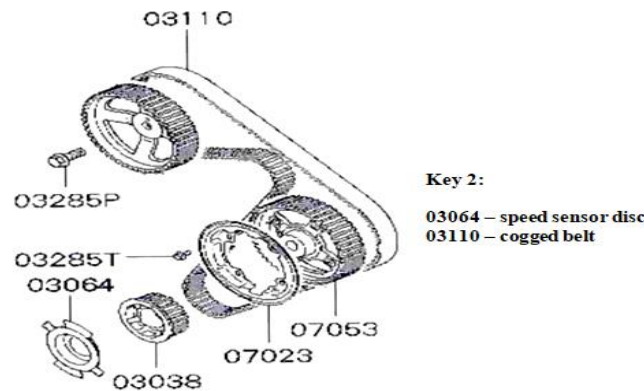


Figure 4: The relative position of speed sensor disc and cogged belt.

VI. DAMAGE EVALUATION

pulley – the internal part of the surface is significantly damaged within the reach of the wedge, traces of excessive turns compared with the position secured by a wedge- Fig.3

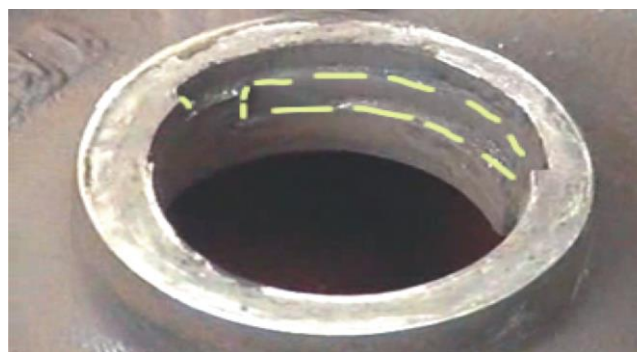


Figure 3: Marked damaged zones on the pulley.

wedge – a broken front part in Fig. 4

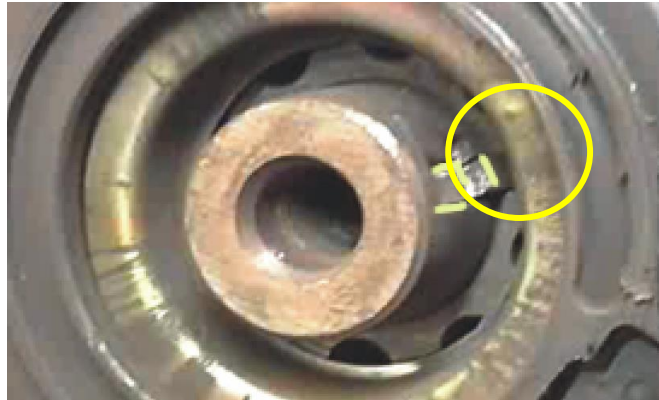


Figure 4: Marked damaged zone on the wedge

crankshaft – damaged, imprints on the internal thread for the pulley bolt in Fig. 5



Figure 5: Marks of the damage to the crankshaft

Pulley bolt washer – significant imprints in the contact area with the bolt in Fig. 6



Figure 6: Marked zone of the damaged pulley bolt washer

Pulley bolt – imprints on the thread at about half of the bolt length, axial clearance detected when fastening into the crankshaft 5 – 8 mm in Fig.7



Figure 7: Marked damaged zones of the pulley bolt

Speed sensor disc – imprints inside the opening for the crankshaft, original diameter increased by about 10 mm – shown in Fig. 8



Figure 8: Marked line of the damage to the engine speed sensor disc

Speed sensor – a damaged sensing part – shown in Fig.9

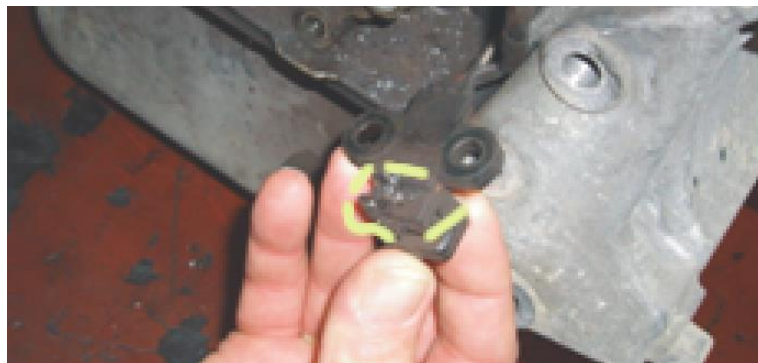


Figure 9: Marked line of the damage to engine speed sensor

VI. LIKELY DAMAGE TO ENGINE PARTS

Analysis of the probable occurrence of the described damage:

Damage to the above-mentioned parts can occur mainly by loosening the bolt of the crankshaft pulley, because of it not being fastened and gradually loosened.

Possible cause of failure: There are typical, obvious signs of the damage due to an unfastened pulley bolt on a crankshaft during assembly process. The said bolt got gradually loosened due to the rotation of the crankshaft, and consequently:

- the internal thread in a crankshaft has been displaced;
- the pulley bolt washer has been jammed against the crankshaft,
- the pulley wedge of the crankshaft has got damaged;
- the opening inner surface of the crankshaft pulley has got damaged;
- the belts driven by the crankshaft has got damaged;
- it has caused the damage to the disc of the engine speed sensor;
- it has caused the damage to the engine speed sensor;
- engine run has started being irregular and incorrect (incorrect speed indication).

The cause of the described technical condition was the loosened crankshaft pulley, the movement of which was related to the changed position and angle to the crankshaft. The extent and the nature of damage correspond with the time of operation from the repairs completed on 18 October 2006, after which the vehicle was in service for 2, 300 km (133, 000 – 127, 700).

VII. CONCLUSION

I consider the pulley bolt not being fastened on the crankshaft properly in an assembly process and consequent loosening the crankshaft pulley the cause of the engine failure of the said **passenger motor vehicle, the Mitsubishi Pajero**. It led to the detected damage to a crankshaft, crankshaft pulley, belts, crankshaft pulley wedge, crankshaft pulley bolt, the washer of the crankshaft pulley bolt, engine speed disc and engine speed sensor. Because of the damage, the engine has run irregularly, and generated obviously incorrect sounds, because the engine has been improperly controlled by a control unit due to the damage to the disc and engine speed sensor. The failure could consequently lead to the emergency failure of the engine piston unit.

VIII. ACKNOWLEDGMENTS

The author of the publication is in no conflict of interest and agrees to the publication.

The manuscript is not in conflict with any natural or legal person.

The presented research was funded by the author himself without any other support.

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Ján Mandelík. “Technical Expertise on the Cause of Engine Failure of the Mitsubishi Pajero Sport.” Invention Journal of Research Technology in Engineering & Management (IJRTEM), vol. 2, no. 5, 24 May 2018, pp. 80–87., www.ijrtem.com.